# CHEMISTRY

BRARY

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Editorial:
Cool and Quiet .....
Inside Front Cover

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# Cool and Quiet

➤ FIRE AND BRIMSTONE are the traditional accompaniments of the chemist. Doubtless the flames, the smells and the noises issuing from primitive chemical laboratories fostered the legend that the experimenter within had sold his soul to the devil.

Early chemists had few processes to work with. Through the verbal mists they created with their obscure language it is occasionally possible to make out the alchemists' directions and recognize the processes they were trying to carry out. The most surprising thing about them is the round-about way they worked.

Trained in metal refining, their work was all with fire. Solution and precipitation "in the wet way" was still undreamed-of.

It was an important step ahead when the alchemists discovered distillation. The process must have seemed mysterious to them, and absurdly simple.

In the same way, today, old fogies may still be found who scoff at new methods which take advantage of small surface forces—catalysis and ion-exchange. "What's so wonderful," they ask, "about just running a solution through a pipe?"

The steps in development of chemical industry are not unlike those in the development of machine design. As the creaks and bangs of primitive machines have been replaced by the purr of the modern motor, the violence of early chemical processes is being superseded by methods which take advantage of quieter forces.

Catalysis often persuades chemicals into combinations that heat and pressure can scarcely force them into. Ion exchange accomplishes, seemingly without effort, what distillation, with its expensive energy changes, balks at.

Soon photosynthesis will join the list of methods which will replace the alchemists' Little Tophet with a chemical factory as quiet and restful as nature's factory, the cool green forest.

**CHEMISTRY**

Vol. 21, No. 11 Formerly The Chemistry Leaflet July 1948
Including The Science Leaflet

Published monthly by Science Service, Inc., the institution for the popularization of science. Publication Office: 119 South Frazier St., State College, Pa. Entered as second-class matter at the Post Office, State College, Pa., under Act of Congress of March 3, 1879. Address communications to Editorial and Subscription Office: 1719 N St. N.W., Washington 6, D.C.

25c a Copy; $2.50 a Year. Two-Year Subscription $4; Your Own and a Gift Subscription $4 Quantity Subscriptions, 10 or more copies to same address: $1.70 a Year. $1 for any seven months, 15c each Copy each Month. No charge for Foreign or Canadian Postage.

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*Consulting Editor*: PAULINE BEERY MACK (Editor 1927-1944)

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Science Service is the educational and scientific institution organized in 1921 as a non-profit corporation with trustees nominated by the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, the E. W. Scripps Estate and the Journalistic Profession.

➤ MINIATURE TOWERS *in the laboratory are used to demonstrate the action of ion exchange resins. One drop per minute on this scale corresponds to two gallons per cubic foot per minute in a commercial installation.*

# For Exchange: Good Ions For Bad

*by* HELEN M. DAVIS

➤ A LITTLE OLD MAN with a salt-mill he couldn't turn off is responsible, according to ancient fable, for the salt in the sea. If this legendary character had thrown his mechanism into reverse and taken the salt out of the sea it would be no less astonishing than the tricks chemists can do today with a process they call ion exchange.

Ion exchange does indeed take salt out of water, and was actually used during the war for providing fresh water for men in life rafts. But its



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the salt. Results were not satisfactory if the order of these two processes was reversed.

It is Resinous Products' unique achievement to contrive a way to do both jobs at once. Two resins of opposite properties are mixed in one column. One of the resins exchanges cations while the other is busy with the anions, and the result is a very passable form of distilled water.

The two kinds of resinous particles must be separated for regeneration, but that is simplified because they are of different densities.

After The Resinous Products and Chemical Co., a branch organization of the Rohm and Haas Co. had developed artificial resins which would act as ion exchange materials, they set about improving upon the natural kind. Several new types of ion exchangers have resulted from this research, one of which is reactivated by weak organic acids. Another is so far over on the opposite, alkaline side that it will change a neutral solution of table salt into one of caustic lye.

As a result of using the new, less acid resins, chemists of the Resinous Products company have worked out a number of applications to problems not heretofore suitable to ion exchange.

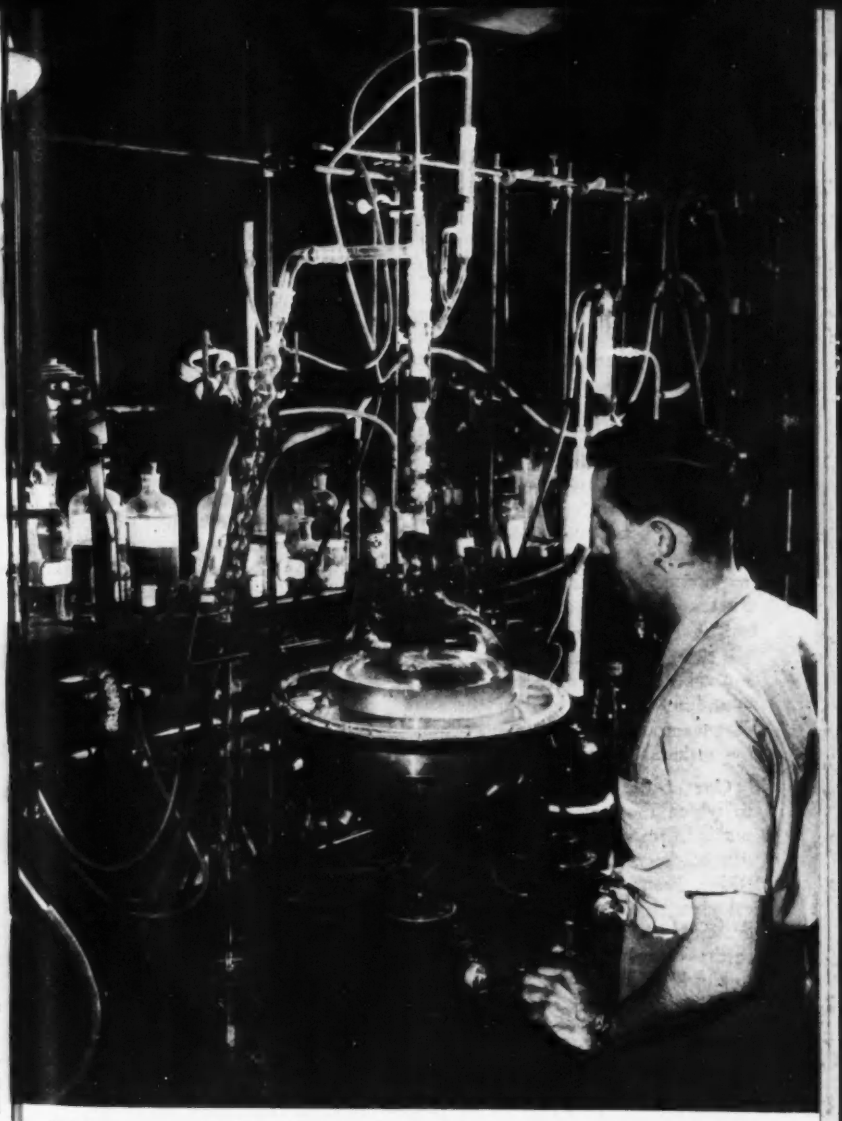
Quinine, the malaria specific, which grows as an alkaloid in the bark of a tropical tree, can be concentrated by one of the new exchange resins. This means a great saving in shipping space, for the extract made by cooking the bark can be passed through an ion exchange tower and the valuable alkaloid extracted from it. After the passage of a large volume of such extract, regeneration with a mild acid will yield a concentrated solution of quinine, which is chemically an organic base just sufficiently ionized in solution to be handled by the resin.

Nicotine from tobacco, which is chemically related to one of the more essential vitamins and which finds industrial use as an insecticide, is also an alkaloid. Chemists of Resinous Products use nicotine to demonstrate the ion exchanger's action in this field because the result is easily seen. Poured in as a pale straw-colored liquid, the solution after passing through the concentrating process comes out a deep golden yellow.

Amino acids, too, can be extracted by other resins of the series. This process is expected to become valuable in several ways. Essential food material can be extracted from certain organic wastes and added to diets, human or animal, in which these nutrient elements are lacking. Careful adjusting of the conditions of use can make the process even more selective. Individual amino acids can be removed from a mixture of several, so that the process can be used for differentiating between them.

Industrial wastes, too, can be salvaged, to the satisfaction of both the manufacturer and the public. Amounts of heavy metals in outflow waters of mines or refineries, which pollute streams but are present in too small amounts to be salvaged by other means, can be concentrated by the new ion-exchangers.

These materials are laboratory-made artificial resins, trade-named Amberlite after the natural fossil resin, amber. They are amber-colored,



➤ BIRTHPLACE *of ion exchange resins, which must be reactive but insoluble. The Resinous Products and Chemical Co. carries on constant research among organic chemicals to find new compounds with the many exacting properties required for this work.*

ranging from light yellow to nearly black, except for the new, pure white, IRC-50, which depends for its action on a strategically-placed carboxyl group.

Since the attraction of ions is a function of the surface, ion exchange resins must be used in the form of small granules. For some purposes a fine powder would be better because of the amount of surface it would offer, but the finer the grains the more difficult it is to get the liquid to go through evenly. Particles that will pass through a screen of 20 holes to the inch but be retained by one of 30 seem to offer the best compromise.

The manufacturer who installs ion exchange apparatus buys the resin in this form, pre-treated according to his requirements and already wet when installed.

This involves a relatively low capital charge for setting up the apparatus, but adds little to operating cost —nothing like the cost of the fuel that would be required to recover the by-products by evaporation.

One of the most remarkable uses to which the new resins have been put is in sorting out the fission products of the uranium furnaces of Oak Ridge. Prominent among the chemical elements thrown off by disintegrating uranium are the so-called rare earths—a series of chemical elements so much alike in their behavior that chemists have labored in vain for more than a century to find chemical tests that will distinguish between them.

A vast amount of controversy has taken place over how many rare earth elements there are. Over and over again new ones have been announced, only to be withdrawn because they proved to be in error. The only method of separating the members of the series—fourteen in all—is by long and tedious "fractionation." A process which will cause a slight degree of separation is repeated over and over, concentrating the bottles holding more of element sought at one end of the series, those containing less at the other.

But now, using suitable ion exchange resins and carefully controlled solutions, it has been found possible to sort out these fourteen puzzlers, as well as other elements, in the order of their atomic weights. Elements never before available in pure form can be investigated.

After a century of headache for chemists, the rare earths have at last been tamed by ion exchange resins. One by one, according to their weights, they come marching meekly out of the tower.

In the pocket of nearly every smoker, the most commonly used of the rare earths, cerium oxide, forms the "flint" of the cigarette lighter. Who knows what uses await Thulium, Dysprosium, Gadolinium, Praseodymium, or even the still-unnamed fission-born Number 61, in the chemical technology of the future?

## *On the Back Cover*

▶ RARE EARTHS *were separated in pure form for the first time in these ion exchange columns at Iowa State College. The exchange resin is Amberlite IR-100, one of the earlier forms of this versatile material.*

**All photos in this series from The Resinous Products and Chemical Co., Philadelphia.**

**Phenolic and Amino Resins Found Able to Remove Ions**

# Pioneer Ion Exchange Resins

## A Classic of Chemistry

*Reprinted here is the summary of the article which inspired Dr. Kirsopp of Resinous Products to bring to America the new process of exchanging both cations and anions in solution, as described in the lead article in this issue of* CHEMISTRY. *It is interesting to note that the authors of this paper planned to soften water by precipitation, then use ion exchange to take out the added salts.*

ABSORPTIVE PROPERTIES OF SYNTHETIC RESINS, *by B. A. Adams and E. Leighton Holmes, in Journal of the Society of Chemical Industry, London, Vol. 54, Jan. 11, 1935.*

### Conclusion

➤ CONDENSATION PRODUCTS of polyhydric phenols with formaldehyde varying from voluminous to hard, compact materials have pronounced and selective adsorptive properties, and, as some of these products may be prepared at an economic price, their applications to the purification of solutions and to the extraction of dissolved substances are practicable. Base-exchange softening of water by means of tannin resins has been described, and although it may be possible to improve their softening capacities, the results in some cases already compare favourably with glauconite and clay types of commercial silicate base-exchange materials. It is also possible to utilize the acid-calcium exchange, in which case the filtrate would contain all the original anions as free acids, yet containing no dissolved salts—a water which might be advantageous in certain industries. Since the resins remove completely both alkalis and carbonates from solution they may be used for removal of lime in the "excess lime" process of water purification and for the removal of the excess of lime and sodium carbonate, as well as the last traces of calcium and magnesium, in a lime-soda-softened water. The removal of ammonia and ammonium salts from boiler feed water, and of iron, manganese, lead, copper, zinc, or other objectionable cations from drinking water, can also be effected by use of these resins.

The amino-resins open up the possibility of the removal of fluorides, silicates, sulphates, chlorides, etc. from drinking and boiler feed water.

By the consecutive use of phenolic and amino-resins it is possible to effect complete removal of dissolved salts from solution, yielding a filtrate equivalent to distilled water. This has been proved for tap-water using first a quebracho tannin resin which removed the cations, and then a *m*-phenylene diamine resin which completed the purification. The total solids were found to be reduced from 33 parts to about 1 part per 100,000. Waters may be encountered having

too high a saline content to allow complete removal in one operation. In this case repetition of the process will produce the required result.

The two types of resins might be applied to the treatment of trade effluents, both for the purification of such liquors, and for the economic recovery of small amounts of inorganic or organic substances. Also the adsorption of rare elements from mineral and other waters may be worthy of consideration, as well as the purification of organic and inorganic chemicals.

As the properties of these resins suggest their application to certain analytical operations we have separated small amounts of arsenic and antimony in slightly acid aqueous solution, the antimony being retained by catechol resin while the arsenic was unaffected. The anion exchange, typified by the calcium sulphate to calcium chloride reaction, may possibly be applied in the preparation of other salts.

Thanks are due to Prof. G. T. Morgan, O. B. E., F. R. S., Director of Chemical Research, for his interest and advice, and for permission to publish these results.

*Chemical Research Laboratory*
*Teddington.*

## *Aluminum for Food Containers*

➤ ALUMINUM containers may become as familiar as the tin cans that now line the shelves in the grocery. Recent studies made in London by the Department of Scientific and Industrial Research indicates that this relatively plentiful metal has many desirable qualities which render it suitable as a material in contact with foods and beverages.

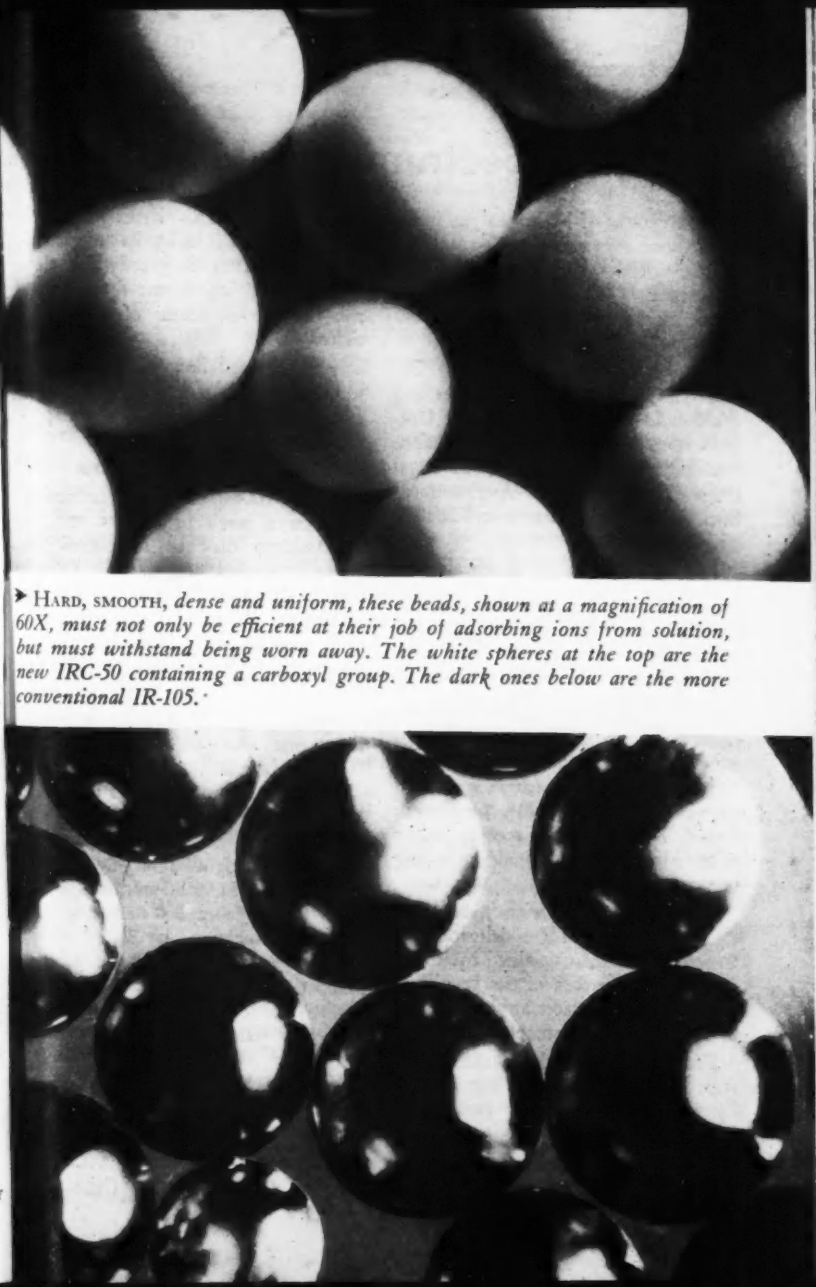
A report just issued by the organization is concerned primarily with an investigation of properties of aluminum and its alloys which might affect their corrodibility. The survey shows that aluminum is inherently a highly reactive metal and that its resistance to corrosion is entirely due to the presence of a protective film of oxide on its surface.

The protective value of this film was studied from many angles, including action by solutions with which it may be in contact, and also its resistance to ionization from substances in solution that might penetrate or dissolve the film.

The findings state that there was no evidence found that any property injurious to health is imparted to foods which have been cooked or held in aluminum vessels, and aluminum neither accelerates the destruction of vitamins during cooking nor catalyzes the oxidation and rancidity of fats. It also has no effect on yeast fermentation.

The investigation was made because of the growing use of aluminum in the food industry for containers and wrapping material. Its use is already well established in certain branches of the industry, the report states, notably in dairying and brewing.

**Fumigation with methyl bromide kills all kinds of armored scales and mealy bugs which trouble orchid growers.**



➤ HARD, SMOOTH, *dense and uniform, these beads, shown at a magnification of 60X, must not only be efficient at their job of adsorbing ions from solution, but must withstand being worn away. The white spheres at the top are the new IRC-50 containing a carboxyl group. The dark ones below are the more conventional IR-105.*

**Hot Hydrogen Robs Star of Evidence of Many Elements**

# Star's Spectrum May Mislead

➤ HOT CLOUDS of hydrogen gas in an active state may rob a star's spectrum of the visible evidence that ample quantities of such elements as calcium, zirconium and magnesium exist in the star.

This theory was proposed by Dr. Jesse L. Greenstein of the Yerkes and McDonald Observatories of the Universities of Chicago and Texas before the joint meeting recently at Pasadena of the American Astronomical Society and the Astronomical Society of the Pacific.

Most of the stars are much alike in the kinds and amounts of elements of which they are composed. But there are many exceptions. A certain peculiar star, about as hot as our sun, for instance, appears to have only about 10% as much calcium, scandium, zirconium, magnesium, titanium and vanadium as does the sun. Other elements, however, are present in normal amounts, Dr. Greenstein found by analyzing spectra taken with McDonald's 82-inch reflecting telescope.

The apparent deficiency of these elements may be only a delusion, Dr. Greenstein reasons. Ionized hydrogen may rob the spectra of the very lines by which astronomers are accustomed to identify these elements.

From below the visible surfaces of stars such as the peculiar one studied by Dr. Greenstein may escape hot clouds of hydrogen gas, itself in an ionized state. This hydrogen, each atom of which lacks its single attendant electron, is greedy for electrons to such an extent that it may rob the nearest atoms of these particles.

The outward flow of some hotter ionized material from the interior of a star may thus upset the star's spectrum.

## Equal Brightness of Stars

➤ THE ALL-IMPORTANT relationship between a star's brightness and its temperature may be simplified because of observations made by Olin J. Eggen of Washburn Observatory, University of Wisconsin.

Blue stars are known to be hot, yellow and red ones are relatively cool. A normal star of the same color and temperature as the sun probably has the same intrinsic brightness, Mr. Eggen believes.

In the past some stars of the same color and temperature as our sun have been considered brighter, some fainter. This is due largely to previous errors in measurement rather than to any complex nature of the stars themselves, he stated. Once again observations with the war-developed photoelectric photometer promise to outmode those made by earlier visual and photographic methods.

Stars in the famous cluster known as Berenice's Hair and the Hyades in the constellation of Taurus, the

bull, were studied because in a cluster sufficiently far away from us we can assume that all the stars are at about the same distance. Thus distance is eliminated as a factor influencing the star's apparent brightness.

All stars brighter than photographic magnitude ten in the Coma cluster were observed during this study. Only some 50 of the 150 stars in the Hyades cluster were examined, the observing season being one of the poorest in recent years for Madison, Wis.

### Methane in Atmosphere

➤ THERE'S LOTS of the hydrocarbon gas methane in the earth's atmosphere. At least there is enough to register its presence upon light from the sun as it passes through our atmosphere on its way to the earth's surface.

A new system of molecular bands in the spectrum of the earth's atmosphere has been identified as belonging to methane, well known "marsh gas," by astronomers of the University of Michigan.

The new all-reflecting infrared spectrometer of the University's McMath-Hulbert Observatory was used for the study. This apparatus employs a Cashman lead-sulfide cell, a hundred times more sensitive than the best thermocouple previously used.

Dr. Robert R. McMath, Dr. Orren C. Mohler and Dr. Leo Goldberg stated that they now have completely mapped with this instrument the solar spectrum in the region 8,000 Angstroms, practically infrared and invisible to the naked eye, to 25,000 Angstroms.

The new solar map shows not only a wealth of solar atomic lines of such elements as hydrogen, iron, magnesium, sodium, silicon, carbon, aluminum, calcium and others, but also numerous well-resolved molecular bands originating in the earth's atmosphere.

Most of these "telluric" band systems come from carbon dioxide and water vapor, as expected. The four new methane bands are at wavelengths 16,600; 22,000; 23,300 and 23,800 Angstroms.

In the absence of adequate laboratory spectra for comparison, the absorption bands appearing in the sun's spectrum were identified conclusively as arising from methane by inserting in the path of the sunlight an absorption cell containing methane at atmospheric pressure. When this was done, the absorption lines identified as due to methane were enormously accentuated, while the remainder of the spectrum was unchanged.

### Meteors Comet Debris

➤ WHEN YOU SEE a "falling star" flash across the sky, you are really looking at a bit of a comet crashing into the earth's atmosphere.

All or nearly all of the bright "falling stars" or meteors you spot are debris of comets, Dr. Fred L. Whipple of Harvard College Observatory told members of the societies.

A determination of the orbits of 45 meteors, photographed at Harvard's stations, showed that 28 belong to one of seven meteor showers, nine were sporadic and eight more were uncertainly associated with showers of falling stars.

The meteors were photographed with small, wide-field cameras at two stations about 25 miles apart. As they

were "caught" photographically at both stations, their height could be calculated. A rotating shutter or fan attached to the cameras chopped the meteor's trail into short lengths so that their velocity could be determined and their orbits in space computed.

For several reasons Dr. Whipple classes bright meteors as debris from comets rather than as bits of minor planets or associated with meteorites, chunks of matter large enough to survive the fiery ordeal of friction as they rush through our atmosphere. He stated:

In many cases the meteors are obviously associated with comets.

Sporadic meteors, shower meteors and short-period comets have similar orbits.

Meteorite falls suggest little or no association with showers of "shooting stars."

Tiny minor planets were probably lost from our solar system in ages long past.

## Magnetism Affects Spectrum

➤ WE MAY some day learn more about distant stars—what they are and how they continue to exist—because of observations reported for the first time by Dr. Horace W. Babcock of Mount Wilson Observatory of the Carnegie Institution of Washington.

Not just a star's temperature and surface gravity, but also its magnetic field, he stated, affect the star's spectrum. It is only by fanning out this starlight into its various parts that we learn which elements make up a distant star, estimate how hot its various layers of atmosphere are and so on.

Dr. Babcock proposed to the American Astronomical Society and Astronomical Society of the Pacific that fluctuations of a star's magnetic field account for hitherto unexplained intensities of certain spectral lines in some white stars. Such changes are also responsible for variations in the spectra of these and other stars.

In stars with high magnetic fields, spectral lines of certain elements may be very much broadened and intensified in appearance. This discovery complicates matters for astronomers, but adds further to our knowledge of the mechanism whereby stars operate.

Dr. Babcock gave as an example the lines of ionized europium in the star known as HD 125248, where these lines vary enormously in intensity with a regular period of 9.295 days. Corresponding to this, the known polar magnetic field of this star also varies. In synchronism with the changes in the europium line, it reaches a maximum of about 7,800 gauss, the strongest magnetic field known in nature.

At maximum the overall width of this star's europium line at wavelength 4205 Angstroms is about .35 Angstroms, compared to only about .023 Angstroms when there is no magnetic effect.

## Explosions May Start Rays

➤ GIANT EXPLOSIONS associated with sunspots on the suns of the universe may be giving birth to the powerful cosmic rays which bombard our earth from outer space.

A natural atom-smasher, a kind of magnetic accelerator, is operating in the neighborhood of sunspots, Dr. Manuel Sandoval Vallarta of Mexico City suggested at a symposium on

cosmic rays at the California Institute of Technology. Such an accelerator mechanism on our own sun may be producing a part of the cosmic radiation on the earth. Acceleration near sunspots on other stars might account for the rest of the cosmic rays, Dr. Vallarta pointed out.

This proposed solution for the mystery of the origin of the potent rays was presented to the National Academy of Sciences last year by Scott E. Forbush of the Carnegie Institution of Washington. He reported that Carnegie Institution records showed an increase in cosmic radiation at times of particularly high activity on the sun. Dr. Vallarta has been working with Carnegie Institution scientists on a theory to explain how the suns of the universe could manufacture cosmic rays.

A new, yet-to-be-discovered cosmic ray particle was forecast at the symposium by a famous French scientist, Dr. Pierre Auger. Dr. Auger described the particle as a lightweight meson. It will have a weight of only three to ten times that of an electron, the tiny, negatively charged bit of atoms.

Known types of mesons, first found in cosmic rays and recently produced artificially for the first time at the University of California, have been assigned measured or estimated weights ranging from 200 to 900 times that of the electron.

The symposium, bringing together outstanding scientists from many countries, was held in honor of 80-year-old Dr. Robert Andrews Millikan, retired head of Cal Tech and a pioneer in the study of cosmic rays.

## Red Stars Grow Fat on Dust

➤ SMALL, RED stars embedded in a dust cloud are growing fat on dust particles falling into them from the cloud, Dr. Otto Struve and Dr. Mogens Rudkjobing of Yerkes and McDonald Observatories of the Universities of Chicago and Texas have discovered.

Very luminous blue and white stars in the dark nebula repel the dust by the outward pressure of their strong light, so that the particles cannot fall into their atmospheres. But the small, relatively cool stars are bombarded by the bits of interstellar dust.

The dust particles seem to supply just the right amount of energy to give the spectra of these stars a number of peculiar bright lines. Dr. Struve characterized as "premature," however, any conclusion that all stars with these peculiar emission-lines are actually being born.

Two years ago astronomers were thrilled by the announcement from Mount Wilson Observatory that Dr. A. H. Joy had observed some 40 stars with strong emission lines in their spectra. These stars were located in the vicinity of the great dust clouds in the constellation of Taurus, the Bull. Dr. Joy suggested that the bright radiations of hydrogen, calcium and other gases might be connected with the presence of diffuse matter in the vicinity of these stars.

In extending this study, the McDonald astronomers obtained spectra of stars in the enormous opaque mass of cosmic dust located in the constellations of Ophiuchus, the serpent holder, and Scorpius, the scorpion, about half way between the bright

stars Rho Ophiuchi and Sigma Scorpii. Stars in this region are mostly faint, and there are few of them. The dark cloud, about two million billion miles away, practically obliterates the light of the stars behind it.

The bright blue-white stars in the cloud were found to have no abnormalities in their spectra, indicating that they were not influenced by the nebulosity. Among the faint stars, a nest of them were found to have peculiar emission lines. Six such stars are close together, located in one of the densest regions of the dark cloud. One of these stars also varies in brightness, indicating that it is definitely associated with the dust cloud.

### Star Blow-off Forms Nova

➤ A NOVA or "new star" appears in the sky when a star literally "blows its top."

A star flares into a nova when a huge shell of very bright material is blown off its surface, Dr. Dean B. McLaughlin of the University of Michigan reported to the joint meeting of the American Astronomical Society and the Astronomical Society of the Pacific.

The outburst, in which the star's apparent brightness may increase 10,000 times in 24 hours, is probably only a single eruption of energy, not a series or train of explosions.

The spectra of two bright novae were carefully examined by Dr. McLaughlin. One of these exploding stars was found in the constellation of Perseus in 1901, the other in the constellation of Gemini, the twins, in 1912. Both stars remained bright only a short time and have since subsided to relative insignificance, the usual procedure for novae.

Light from a shell of gas approaching the earth at the rate of about 400 miles a second was the most prominent feature of the spectrum of Nova Persei. It was present within a day after the star's maximum brightness and still prominent 18 months later. Many years later a nebula with exactly this same velocity was visible, expanding around the star.

There is some evidence of more than one outburst for Nova Geminorum. But all the prominent structural features of the expanding shell were present within four days after the star's maximum light had been reached.

### Sunspots Spoil Radio Bands

➤ IF THE ANTICIPATED decline in sunspots comes within the next year, shortwave radio enthusiasts will have to become accustomed to using different frequencies, Dr. Harlan T. Stetson states.

Citing as examples recent observations at the Cosmic-Terrestrial Laboratory of Massachusetts Institute of Technology, Dr. Stetson showed that a frequency which could be used on a typical path in 1944, when there were few spots on the sun, had become practically useless by 1947, when sunspot activity was at its peak.

**Among the fireproofing agents used to impregnate wood are ammonium, calcium, zinc, cupric and magnesium chlorides; ammonium, aluminum and nickel sulfates; certain borates and nickel, zinc, magnesium, and mono and di-ammonium phosphates.**

# Song of Advancing Science

*Women scientists are working on Britain's atom secrets at Harwell. A Ministry of Supply spokesman said: "There are not many jobs in the atomic field which women cannot do."*

*—News item.*

WHEN lovely woman turns to science
And finds the atom fills the bill,
Shall we not place complete reliance
On her capacity and skill?

Then in the day when wrath unleashes
The dogs of war on this new trail,
Shall not the female of the species
Prove quite as deadly as the male?

Why, yes, of course — there's nowt to stop it;
Gone are the days when woman's art
Was wasted as a household poppet,
A plaything in a minor part.

We reach a more enlightened sequel
Where sheer ability prevails
And backroom boys and girls are equal
Performers on atomic scales.

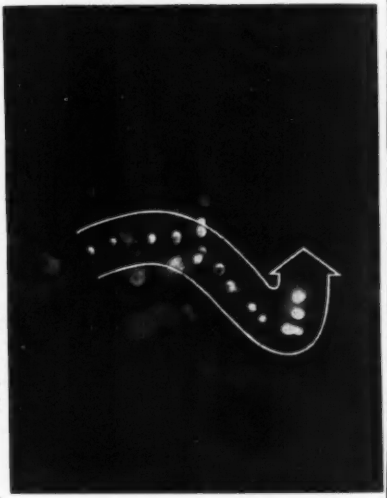
So rises Eve's accomplished daughter
From household chores to higher scope
As mistress of the heavy water,
The cyclotron and isotope.

Down with the saucepan and the ladle,
Let sterner tackle take their place—
The former hand that rocked the cradle
May yet disrupt the human race.

LUCIO, *in the Manchester (Eng.) Guardian.*

**Recent Advances in Photography Aid Nuclear Science Study**

# Elusive Tracks of Electrons



➤ ELECTRONS, known as particles of electricity, are the commonest of the fundamental bits of matter, and scientists work with them daily.

Yet only now have electron tracks been definitely photographed. Eastman Kodak scientists announced that tracks about two thousandths of an inch long —less than the thickness of this piece of paper—have been captured in a special photographic emulsion.

This picture was developed after an electron sped through the emulsion, striking silver grains in its path. It shows an enlargement of a 13-grain track. X-rays, filtered through lead, were used to start the electrons flying into this new type of plate.

## New Plate for Mesons

➤ A NEW and special kind of photographic plate is being used in Bristol, England, to take pictures of mesons, small cosmic ray particles.

The new Ilford photo emulsion has been developed to photograph the trail of these elusive particles in the laboratory of Dr. C. F. Powell. This emulsion contains eight times as much silver bromide as older emulsions in order to magnify the path of a particle on the photographic plate. It also is loaded with boron, which prevents the tracks left by the particle from fading and makes the emulsion less sensitive to light.

Since pre-war days it has been possible to take pictures of protons, deuterons, alpha particles and fission fragments on photographic emulsions, but until recently it has been very difficult to distinguish between the tracks left by the different particles. In addition, very light particles could not be traced because they did not have enough energy to leave much of a trail in the emulsion.

Since cosmic rays are believed by scientists to come from outside the atmosphere of the earth, perhaps from the stars, plates to catch the traces of these rays in the form of mesons are exposed on the tops of mountains. Only when the meson actually ends up in the emulsion can one be sure that the trail in the emulsion is due to a meson and not any other particle.

The plates after exposure are examined under strong microscopes by the scientists. By studying the plates they are able to determine the mass of the meson, evidences of nuclear degeneration and other facts which increase our knowledge of the hitherto little known cosmic rays.

## *X-Ray Picture Exposure Halved*

➤ EXPOSURE time for taking an X-ray picture will be cut in half with use of a new high-speed X-ray intensifying screen now in production by the Du Pont Company.

Most important of the many advantages this offers is the decrease in time the person having an X-ray picture made will need to be exposed to the rays. Since there is a limit to the amount of X-radiation that can be given, doctors are careful to expose a person to as brief an amount as possible in taking pictures for diagnosis. This is particularly important if the patient is likely to need X-ray or radium treatment later.

Difference between the new screen and present-day screens is in chemical composition. The new screen is made possible by use of a luminescent chemical new to the field, barium lead sulfate. This chemical is stable both to X-rays and to light rays.

Calcium tungstate is the chemical which has previously been used as the principal component of intensifying screens for X-ray pictures. The new screen extends the distribution of fluorescence from 2800 angstrom units to 4600 angstrom units, with the maximum response at 3800. This is much further into the ultraviolet than the calcium tungstate screens extend.

The new screen should reduce the costs of X-ray pictures because it will increase the capacity of smaller X-ray outfits, such as portable ones, will save tube life in the big machines and will take more pictures in the same time.

## *New, Safer Movie Film*

➤ A NEW SLOW-BURNING type of motion picture film base developed by the Eastman Kodak Company is claimed to be safer than the so-called safety film now used in home movies. It is described as a "high acetyl" acetate type, and it is intended to replace the cellulose acetate propionate base film.

It may also replace the cellulose nitrate film which is now widely used for professional motion pictures. It has proven satisfactory under tests of special prints of several feature pictures that were circulated through film exchanges in different parts of the country.

Nitrate film burns rapidly. Safety film generally is a slow-burning type. The low shrinkage of the new safety base will also keep the film free from buckle and the resulting in-and-out of focus images on the motion-picture screen. The new film has tensile strength comparable with the nitrate type and equal projection quality.

**Antibiotics, Vitamins, Other Chemicals Combat Human Ills**

# Chemicals Against Disease

➤ FROM MANY laboratories in many parts of the nation, new developments in using chemical methods for treatment of disease are reported.

## Anti-Vitamin for Cancer?

➤ DISCOVERY that an anti-vitamin can interfere with the activity of a hormone, specifically a female sex hormone, has been made by Dr. Roy Hertz of the National Cancer Institute.

A new principle in treatment of disease may result. This new principle could apply not only to treatment of cancer but also treatment of many other diseases in which glands and their hormones are involved.

Dr. Hertz worked with chickens and monkeys. He gave the animals doses of a chemical called aminopterin. This is an antagonist, or anti-vitamin, to folic acid. This anti-vitamin stopped the growth response of chick tissues to the female hormone, estrogen.

The effect of hormones on the growth of tissues has recently been considered important in connection with cancer, which is a problem of abnormal growth. A relation between sex hormones and cancer of the breast is also known to exist and a number of scientists are working on this phase of the cancer problem. Some of them have been discussing their work at the meeting here.

Cancers of the breast and uterus are known to have a certain dependence on stimulation by estrogens. In breast cancer it has been common practice to remove the patient's ovaries, or destroy them by X-ray or radium treatment. The object of this is to stop their production of estrogen, in the hope of stopping the estrogen-stimulating effect on the cancer.

Dr. Hertz' discovery of the anti-folic acid chemical's effect opens the possibility of using this chemical instead of removing or irradiating the ovaries. It might prove even more effective, because it would also stop the activity of estrogen from sources other than the ovaries, such as the adrenal glands.

The relation between folic acid and estrogen stimulation was first observed by putting chicks on diets that contained none of this vitamin. Trial of the anti-folic acid chemical came next. Diets lacking other vitamins, such as riboflavin, pantothenic acid and pyridoxine, were also tested. But they did not have much effect on estrogen stimulation.

The possibility that other hormones may depend on "trace factors" in the diet, such as vitamins, is opened by the discovery. The fact that there are many anti-vitamins as well as many vitamins, expands greatly possible application of this new principle in treatment.

## $B_{12}$ for Pernicious Anemia

➤ A FEW SMALL, red, needle-shaped crystals injected by hypodermic needle once in a while instead of half a pound

of liver to be eaten every day or liver extract injections every week for life—that is the pleasing new prospect for pernicious anemia patients.

It results from the discovery of a new vitamin, which has been named $B_{12}$. The red vitamin crystals seem to be the chemical in liver which does the job of checking or controlling pernicious anemia, much as insulin controls diabetes.

The new vitamin was isolated from liver by Edward L. Rickes, Dr. Norman G. Brink, Frank R. Koniuszy, and Drs. Thomas R. Wood and Karl Folkers of Merck and Co. research laboratories at Rahway, N.J.

Three patients have been given the new vitamin under the direction of Dr. Randolph West of Columbia University's College of Physicians and Surgeons. A single shot of a very tiny amount of the vitamin promptly started formation of new red blood cells and brought about an increase in number of red blood cells and hemoglobin.

It is still too early to say whether the blood will return to normal without further doses of the vitamin, Dr. West cautions. But it may be possible by giving a sufficiently large dose to produce a prolonged period of freedom from symptoms. This would free the patient from the annoyance and expense of the more frequent injections now required.

The vitamin is so powerful that the single dose which brought improvement in anemia patients weighs only about as much as one two-hundredth of an inch of a human hair.

Patients will not be able to get the new vitamin for some time. There is so little of it that it cannot even be supplied to research workers in other institutions for study. It took tons of liver to get two or three milligrams of the vitamin, and 1,000 milligrams are the equivalent, approximately, of only one-thirtieth of an ounce.

Important to discovery of the new vitamin was the finding of a suitable kind of guinea pig for testing the compounds the chemists were extracting in the search for the vitamin. Testing these substances on patients was not practical because not enough untreated pernicious anemia patients could be found. The guinea pig used is not a pig at all, but a microorganism called Lactobacillus lactis Dorner. Its suitability for the vitamin testing was discovered through studies by Dr. Mary S. Shorb of the University of Maryland.

### New Vitamin Link

➤ Discovery and synthesis of a new chemical compound which forms a third link in the chain leading to production in the body of the pellagra-preventing vitamin has been announced by Dr. H. K. Mitchell and associates of the California Institute of Technology.

The chemical, known as 3-H for short, can also be obtained from love-in-the-mist, though it is unlikely you will be chewing the seeds of this plant, known botanically as Nigella, to get your daily ration of the vitamin.

The vitamin is niacin, or nicotinic acid, known for years as both cure and preventive of pellagra. More recently it was discovered that a quite different chemical, tryptophane, could be substituted for nicotinic acid in the

diet of rats without any damage to the animals. They grew just as well on one as the other.

Tryptophane is an amino acid, one of the building-blocks of protein. Rats can get along without nicotinic acid if they are given tryptophane because, it is believed, they convert the tryptophane into nicotinic acid in their bodies. Proof for this conversion, however, has not yet been obtained.

Dr. Mitchell and associates, working with the red bread mold known scientifically as Neurospora, uncovered two steps in the chemical conversion chain. Tryptophane breaks down into a second stage to become a compound known as kynurenin. This is a result of a rearrangement of the atomic pattern of tryptophane.

In a third stage in the conversion, just discovered, a side chain of atoms is discarded. This results in the new compound, 3-H, known chemically as 3-hydroxyanthranilic acid.

Feeding certain strains of the red bread mold, Neurospora, any of the three isolated chemical compounds causes an increase in their production of nicotinic acid. Tests are now being made with rats and preliminary work has shown that feeding these animals any of the three compounds results in their excreting more nicotinic acid.

Whether it will work in man remains to be seen but Dr. Mitchell points out that surprising number of chemical mechanisms are common to both large and small organisms.

## Dye vs. Virus

➤ Viruses, the submicroscopic, almost-alive chemical compounds that cause many serious diseases in plants, animals and man, may some day be conquered with chemical weapons, as bacteria have been overcome by the sulfa drugs and such mold-derived compounds as penicillin and streptomycin. Experiments on the tobacco mosaic disease of plants by Dr. William N. Takahashi of the University of California, seem to point in this direction.

Dr. Takahashi used malachite green, a well-known synthetic dye, in very dilute solution on tobacco leaves inoculated with the mosaic virus. The number of diseased spots appearing on the treated leaves was a very small fraction of the number that appeared on untreated leaves used as controls.

In these experiments, the dye was used as a research tool rather than as a possible remedy. Dr. Takahashi knew that viruses can multiply only in living cells, and reasoned that they steal the use of certain enzymes, which are compounds used by the cell in its own life processes, to carry on the parasitic life of the viruses. He knew that malachite green blocks the action of some enzymes, and yet is not too poisonous to the whole plant. Results of his work are evidence in favor of his hypothesis. Further evidence is found in the fact that malachite green has no effect on solutions of virus in water, with no cells or enzymes present.

Hitherto no chemical treatment has been effective against virus diseases, with a few exceptions. However, if further research with other chemicals indicates exactly which enzymes in the cell the virus borrows for its own nefarious purposes, a long step toward the conquest of the viruses will have been taken.

## Undulant Fever Cure?

➤ THE COMBINATION of a sulfa drug and streptomycin, anti-germ chemical from an earth mold, may provide a cure for undulant fever, it appears from a report by four University of Minnesota medical scientists, in the Journal of the American Medical Association. The scientists are Drs. Wesley W. Spink, Wendell H. Hall, James M. Shaffer and Abraham I. Braude.

Nine patients recovered from the disease completely when given both streptomycin and sulfadiazine. Neither drug alone, nor any other treatment, has given as good results. An even more effective weapon against the disease may come from the intensive investigations now being made of other drugs like penicillin and streptomycin.

The treatment was effective in both acute and chronic undulant fever. Particularly encouraging is the fact that it was effective in complications of the disease such as subacute bacterial endocarditis (a form of heart trouble) and the spinal disease, spondylitis.

The idea of using both drugs together came partly from tests the scientists were making on chick embryos and partly from experience with a patient who had improved when treated with streptomycin alone.

Toward the end of treatment and after the streptomycin was stopped, undulant fever germs in his blood were found to have developed resistance to streptomycin. The germs proved rather sensitive to sulfadiazine in laboratory tests, however, so the patient was given large doses of the sulfa drug. Whereupon his fever disappeared and there were no more undulant fever germs in his blood. Unfortunately, he had developed a severe heart inflammation and died suddenly of heart failure, although the germs that had caused the heart trouble had been eradicated.

The chick embryos had been used instead of guinea pigs to provide a faster way of screening possible remedies for undulant fever. Five sulfa drugs, penicillin and streptomycin were each tested. Although the sulfa drugs and streptomycin each, when used alone, prolonged the lives of infected chick embryos, none of the remedies alone was very effective in killing the germs. But the combination of large doses of sulfadiazine with streptomycin did bring about 100 per cent sterilization of the undulant-fever-infected chick embryos.

Undulant fever is also known as Malta fever and brucellosis. The germs are called Brucella, after Sir David Bruce, British medical officer who first discovered them. The disease attacks cattle, swine and goats and is responsible for heavy economic losses in livestock. Cattle owners in the United States lose more than $50,000,000 annually, swine owners more than $10,000,000 through this disease, it is estimated. Among humans there are believed to be 30,000 to 40,000 active cases annually.

Humans get the disease through contact with infected animals, their secretions and carcasses, and from drinking raw milk from infected cows and goats. The disease is rarely spread from one human to another.

## Tuberculosis Meningitis

➤ SIX out of seven babies and children suffering from tuberculosis meningitis

have been saved by treatment with streptomycin and promizole.

Their cases are reported by Drs. Edith M. Lincoln, Thomas W. Kirmse and Estelle De Vito of Bellevue Hospital and New York University in the Journal of the American Medical Association.

The six children who survived this usually deadly disease have not been under observation long enough for their doctors to call them "cured." But they are all living three to eight months after the start of the treatment and they are all normal mentally with no signs of nerve damage except mild ones in two.

"Streptomycin," the doctors state in their medical report, "has revolutionized our attitude toward tuberculosis meningitis. Before this antibiotic was discovered the outlook was hopeless."

Some patients have apparently been cured by the mold remedy alone. But in some cases reported by other physicians, although the disease was apparently arrested by streptomycin, the patients later relapsed and died. And some patients who survived were left with extensive damage to the nervous system.

The decision to combine streptomycin with promizole was based partly on results of the combined treatment when given to laboratory animals. Using the two together, Dr. M. I. Smith of the National Institute of Health had reported, heightens the action of the two remedies beyond the expected value of either alone.

Promizole, which is in a way a relative of the sulfa drugs, brought encouraging results in the treatment of another kind of tuberculosis, the New York doctors had found. Promizole can apparently be given safely and effectively over a period of years, and can be taken by mouth, but it is slow to take effect. Streptomycin, on the other hand, acts quickly on the TB germs but cannot be given by mouth and is more toxic than promizole. It has also the disadvantage that the germs may develop resistance to it. By giving the two drugs together the doctors thought they might get the benefit of the peculiar advantages each has.

The results seem to bear this out and the doctors hope others will be encouraged to try the combined treatment.

## Against Whooping Cough

➤ FIRST TRIALS in patients of a new penicillin-like remedy active against whooping cough are reported by Dr. P. N. Swift of the County Hospital, Farnborough, in the Lancet, a medical journal published in London.

The 10 little patients, whose ages ranged from one month to two and one-half years, all showed a definite response within the first 48 hours. Two of the 10 died. In both of these the drug seemed to control the disease, and the whooping cough was not considered the direct cause of the deaths. The other eight recovered, the speed with which they got well depending on how early in the disease the new drug was started.

Aerosporin is the name of the new drug which may turn out to be a remedy for typhoid fever as well as for whooping cough. While penicillin comes from a mold, aerosporin comes from a bacterium found in soil and air and in the tap water in an Ameri-

can city, Chicago. It was discovered by Drs. G. C. Ainsworth, Annie M. Brown and G. Brownlee of the Wellcome Physiological Research Laboratories.

Aerosporin is "more discriminating" than streptomycin, test-tube studies reported by Drs. Brownlee and S.R.M. Bushby show. It has no action against the tuberculosis germ. But for germs against which it is active, it is 10 to many hundred times more powerful than streptomycin.

The new antibiotic not merely checks germs but kills them. It has the further advantage that disease germs do not readily grow resistant to it.

It cannot be given by mouth, because it is not absorbed from the stomach or intestines. It is more acutely toxic than streptomycin but its greater anti-germ activity gives it a large margin of safety. A kidney-damaging effect was gotten rid of as the drug was further purified. Aerosporin is not yet available commercially.

### Atomic Goiter Cure

➤ RADIOACTIVE iodine from the atomic pile at Oak Ridge, Tenn., has "cured or definitely improved" 12 out of 18 toxic goiter patients, Dr. R. A. Shipley and associates of Western Reserve University have reported. The other six patients are expected to improve on further treatment.

The type of goiter treated is that in which the thyroid gland is overactive. Familiar symptoms are popping eyes, thinness and nervousness. Although various medicines have been used to treat the condition, relapses have run as high as 50 per cent. For permanent cure of the condition, a surgical operation to remove the overactive gland is usually necessary.

Because the thyroid gland has an avidity for iodine, taking it up as fast as the body acquires it, the radioactive form, through its radioactivity, can produce the curative effect.

The radioactive iodine used is one with a half-life of eight days. It is given as a tasteless mixture in a glass of water. Definite shrinkage of the goiter occurred in two weeks, with the patient feeling definitely better in that same period. Recovery occurred four to six weeks after treatment.

Reporting the results with Dr. Shipley to the Academy of Medicine in Cleveland were Drs. A. M. Potts, J. P. Storaasli and Hymer L. Friedell.

## *Chemicals Check Bleeding*

➤ SCORES of patients bleeding from leukemia or other disorders have had their bleeding stopped by doses of a dye, toluidine blue, or another chemical called protamine. For an exhibit demonstrating this discovery, Dr. J. Garrott Allen and associates of the University of Chicago received the American Medical Association Gold Medal.

The chemicals do not cure leukemia, and they are not effective in hemophilia, hereditary bleeder's disease. They were discovered during search for means of combatting hemorrhage in irradiation damage, as from atom bombs. They stop the hemorrhage in irradiated dogs, but prolong life only slightly.

# Frivolous Effervescence and Caustic Comment

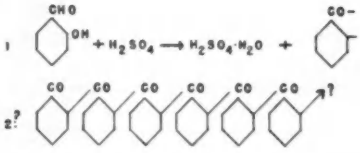
*by* Our Readers

➤ "We find considerable enjoyment and advantage in using Chemistry in my class in that subject, and hold regular current events discussions based on this magazine."

R. C. R., Ritzville, Wash.

* * *

➤ "During some recent experiments with high polymers, I treated o-hydroxybenzaldehyde with a small quantity of cold, concentrated sulfuric acid and obtained a red solid. During the reaction, small droplets of a colorless liquid were momentarily formed in the o-hydroxybenzaldehyde. If this liquid were water, then the red solid might be a polymer of the o-hydroxybenzaldehyde, from which one molecule of water had been split off each molecule, as follows:




"Could you please tell me if these reactions are what occurred, what radical would hold the free bonds at the end of the chain, and if p-hydroxytoluene, p-aminophenol, and hydroquinone could be dehydrated and be made to polymerize in a similar manner, with a $CH_2$, NH, and O radical respectively substituted for the CO in the given polymer?"

D. R., Perry, N. Y.

* * *

*How about it, high polymer fans, can anybody help?*

* * *

➤ "It has been my belief that a magazine, capable of bringing the great humanizing values and the facts of science to the layman and especially the high school and young college student, would function as a very important factor in our educational system," writes Mr. C. N. F. of New York City. "Man has used science extensively during the last 100 years but few people have understood its fundamental philosophy, nor how the facts of science are acquired. Consequently, science has not affected their mental processes, except indirectly.

"It is hoped that the contents of Chemistry will influence the readers to take their part in supporting scientific research, in interpreting it and in organizing society in such a manner that science will be able to make progress. Science should have satisfactory tools and cooperative support, so that it can perform its true function as a blessing to humanity."

➤ THERE IS NO *excuse now for having poison ivy or poison oak on your premises. New weed-killing chemical sprays make it easy to rid yourself of this uncomfortable and dangerous neighbor.*

# Chemical Warfare on Poison Ivy

*by* DR. FRANK THONE

➤ POISON IVY has no longer any excuse for staying alive, at least in places where it can exert its evil effects on sensitive skins. Once it was just about the hardest of all weeds to get rid of. Now the agreeable task of killing it is easy, thanks mainly to two war-born chemicals, 2,4-D and Ammate.

Both of these designations are not really names; rather they are time-saving labels. 2,4-D might be called the initials of 2,4-dichlorophenoxy-acetic acid. Ammate is a trade name, made by combining the first and last syllables of ammonium sulfamate. You are going to hear more and more about them as time goes on, so here's as good a place as any to get acquainted with them.

2,4-D has already gained quite a reputation as a lawn-cleaner, because of its peculiar property of killing broad-leaved weeds like dandelion and plantain while not harming most kinds of grass. It is, in fact, poisonous to all broad-leaved plants, desirable ones as well as weeds, which is why you can't use it to kill the weeds in your vegetable and flower gardens — it would kill the potatoes and petunias, too.

2,4-D is one of that large class of chemical compounds that in small doses stimulates plant growth but in larger quantities cripples and kills. Just as a twentieth-grain pill of strychnine will pep you up, but twenty grains will kill you.

One of the hush-hush projects of the recent war was the use of 2,4-D as a biological warfare weapon, to cut enemy food supplies by damaging certain of their crops. It was never put to use for that purpose, but after the war its use on green enemies here at home, the weeds, seemed logical. So it is now on the market in various prepared formulations, ready to be mixed with water and poured into the sprayer tank.

It is not a quick killer. When you first spray it on poison ivy, nothing happens. But after some days the leaves begin to take on a distorted, crippled appearance. After two or three weeks the plant is dead, roots and all.

There was no great wartime secrecy about the other killer chemical, ammonium sulfamate or Ammate. A new weed eradicator was needed to replace previously used compounds like sodium arsenite and the chlorates of sodium and potassium, which had been drafted for war purposes. As sometimes happens, the substitute proved better than the original materials. Now it is readily obtainable everywhere.

Ammate has one considerable advantage over 2,4-D, in that it acts fast. Within 48 hours after spraying, poison ivy leaves are dead and out of action. For this reason, Dr. L. W. Kephart, head of the weed-war activities of the U. S. Department of Agriculture, prefers Ammate where quick results are desirable, as in school yards and playgrounds.

Principal drawback to Ammate, at least for large-scale operations, is its cost. Dr. Kephart estimates that it costs about 20 cents a gallon to prepare Ammate spray solution, as against only one or two cents a gallon for 2,4-D. So he recommends the costlier Ammate for places where every day that the poison-ivy leaves survive means that much additional risk of itching, blistering torment for sensitive skins. For more extensive killings in less frequented places, the more economical 2,4-D spray is satisfactory.

Dr. Kephart also has a place in his anti-ivy arsenal for an old, familiar chemical killer, common borax. Scatter the dry powder on ivy-infested areas at the rate of 10 or 15 pounds per square rod, he says, and the plants will die in the course of a month or six weeks. He warns, however, that borax is likely to harm other plants growing in the same areas, especially flowering dogwood.

The coming of Ammate and 2,4-D has been a good thing in another way, too. Chemical attacks on poison ivy were sometimes made, in the past,

with oil or with the chlorates of sodium and potassium. Both of these are bad fire risks. The oil itself is inflammable, and the chlorate-impregnated dead leaves were almost explosively combustible.

One thing, of course, must be remembered when planning your chemical campaign against poison ivy: both Ammate and 2,4-D kill many other plants as well. 2,4-D has a selective action: it will kill any broad-leaved plant but spares practically all grasses. Ammate kills all plants on which it is sprayed. So it will be necessary to keep your spraying operations away from shrubbery, flower-beds and vegetable gardens, even if there is poison ivy in them.

That does not necessarily mean that the evil vine must be left undisturbed in such places. You can lay down your sprayer and apply some 2,4-D solution with a small brush or a cotton swab tied on a stick. It isn't necessary to get it on every leaf; from a few leaves, sometimes even from one, the absorbed poison will be carried all through the plant, and will slowly but inexorably kill it.

Similarly, if a poison-ivy vine has climbed into one of your favorite trees you don't have to spray its top, thus getting the toxic dose on the tree's leaves as well. Just cut the vine in two close to the ground. The top will die from lack of water, and the underground parts will soon send up new shoots. Then you can spray these, and thus kill the roots.

## Community Effort Needed

➤ Fighting poison ivy is more than an individual job. It requires the cooperative efforts of the whole community if the battle is to be decisively won. For it should be a battle — total war against a ruthless enemy that brings misery to little children as readily as to grown-ups.

Poison ivy might even be said to be especially an enemy of children. Children play, and when they play they cannot be expected to be as cautious and prudent as adults. They will wander the woods, scramble over fences, climb trees — and in all these places they will encounter poison ivy.

The littlest children, with the tenderest skins, are too young to be taught how to recognize the three-leaved menace. Older children may be taught, but in the excitement of their play they will often forget. Even older persons are sometimes distracted by other matters, and thus get into trouble with it.

Poison ivy not only lies in wait for its victims in woodland walks and playgrounds; it gets into the most frequented of places where green things grow at all. Schoolyards, playgrounds, parks, plantings around public buildings are all apt to be invaded by the poisonous pest. It gets into the shrubbery around country clubs; it makes the "rough" by the golf links even rougher. It drapes itself on trees along bridle paths and hiking trails. It seems to be endowed with the ubiquitousness of Satan himself.

Because it is everywhere, ready to attack everybody, everybody should attack it everywhere, now that effective chemical weapons are available.

A highly successful community campaign against poison oak was waged last year in Berkeley, Calif. The noxious shrub had formed dense masses on unoccupied land alongside the city streets and had even invaded the University of California campus. It was sending so many casualties to the University infirmary that something simply had to be done about it. Dr. C. E. Turner, at that time Professor of Public Health on the University faculty, planned and carried through a campaign that can very well serve as a model for similar action elsewhere, with such modifications as may be needed to meet local conditions.

It would, of course, be possible to hire professional pest control operators to do the whole job; most of the well established firms have well-trained corps of workers who are very effective in action. There are two good reasons, however, for not leaving everything to professionals.

One is that by so doing you are passing up an excellent chance for education in civic cooperation. It becomes like hiring mercenary soldiers to fight a war. It is preferable to have as many citizens as possible working together towards a common end. And a poison-ivy war has the great advantage of being at once important and non-controversial. It is like being against sin, only maybe more so.

The second reason for getting the whole community into the fight against poison ivy is tied up with the relatively slow action of 2,4-D, which because of its low cost will be the preferred weapon. A commercial eradicating firm is not likely to have equipment enough to cover all the necessary ground in a few days, whereas if a concerted attack is made by everybody in town who owns a sprayer of any kind every poison-ivy plant in the battle area will get its death dose in a day, or at most a few days, and the two or three weeks of its dying-time will be up all the sooner.

Here, condensed to tabloid form, are the principal moves made by Dr. Turner in the poison-oak Battle of Berkeley: First he studied up on the plant and got out a mimeographed information bulletin about it. He also got facts about hospital records of bad poisoning cases. Armed with these facts, he held conferences with health, medical and recreational leaders, and got them sold on the campaign. Informational literature was prepared for general distribution, endorsements given publicity, articles published in the papers, radio talks made, rallies held.

Students in the grade and high schools, as well as the enormous student body of the University of California, were recruited for the drive. Clubs and commercial organizations were informed and kept interested. Many pictures were used. Everybody was made poison-oak conscious.

To make sure of sufficient weapons and ammunition, hardware dealers and seedsmen were kept informed of the magnitude of the campaign. Commercial spraying concerns were alerted.

After a build-up of this kind, it is no wonder that Berkeley went far on the way towards being the first poison-oak-less city in California. Follow-through work will be required, to catch clumps that escaped,

▶ "BEFORE AND AFTER" *in one photograph. A strip of poison ivy right through the middle was sprayed with 2,4-D, leaving the growth to right and left unsprayed. Effectiveness of the treatment is dramatically evident.*

sproutlings from dormant seed, etc., but keeping them down will be a relatively simple matter.

In selecting spraying squads for a community anti-poison ivy campaign, it would be a good thing to pick out, for action in places where the enemy is thickest, those fortunate individuals who can handle poison ivy without being poisoned, or those others, somewhat more numerous, who react only slightly. Even these, however, should be well covered with protective clothing and gloves, for it is generally agreed that there is no such thing as absolute, lifelong immunity.

The concentration ordinarily used in attacking poison ivy with 2,4-D is one-tenth of one per cent, or one pound of 2,4-D to 125 gallons of water. The spray does not have to be applied thickly; if only a few drops per leaf stick the evil vine will die. Spray must not be allowed to fall on gardens or other desirable plants; 2,4-D kills all plant life except grasses. This caution should be remembered especially by operators of the bigger spraying machines. However, if masses of other undesirable plants, such as ragweed, burdock or Japanese honeysuckle, are encountered, they might as well be sprayed. Ragweed is not due to shed its pollen quite yet, and its flowers can be aborted if it gets a little 2,4-D on its leaves now.

## Treatments, But No Sure Cure

➤ Poison ivy's blistering, burning, itching affliction is an old story in this country. The earliest colonists encountered it. Here is a description, believed to be the first ever printed, that dates back to 1609, when Jamestown was new:

"The poisonous weed, being in shape but little different from our English yvie; but being touched causeth reddness, itchinge, and lastly blysters, the which howsoever, after a time they passe awaye of themselves without further harme; yet because for the time they are somewhat painefull, and in aspect dangerous, it hath gotten itselfe an ill name, although questionlesse of noe very ill nature."

The writer of this passage was none other than the redoubtable Captain John Smith, who has been regarded for a good many years as a first-class freehand liar. Evidently the Captain could tell the truth when it suited him, and even play it down a bit. Present-day physicians not only give the plant an ill name but consider it as having a very ill nature indeed.

Before white men discovered poison ivy the Indians knew it. It poisoned them, too; claims of immunity for copper skins are unfounded. In fact, it is likely that Indians may have had more trouble with it than white men, for their men at least went about in summer practically naked. Mythical, too, is the statement that Indians immunized themselves by swallowing the leaves of the plant. If any Indian ever told a white man that, it probably was to test his credulity and see whether he'd be fool enough to try it.

Practically every native plant with juicy leaves or stem has been described as an "old Indian remedy" for ivy poisoning. Maybe so; Indian medicine men sometimes used some very queer ingredients in their potions. White

men, with much loftier claims for scientific medicine, made their search for a cure with considerably more persistence than success for a long time. Dr. James B. McNair, who published a book on ivy poisoning about 20 years ago, compiled a list of nearly 300 drugs and chemical compounds that have been described in medical literature as poison-ivy remedies. They range through the alphabet from Alum to Wormwood.

Trouble with most of them was that they were purely empirical, just gropings in the dark for something that would neutralize a poison of which nobody knew the true nature. Dr. McNair isolated the poisonous principle, analyzed it, and proposed a preventive and remedy that works in a good many cases.

The name that Dr. McNair proposed for the poison, however, had to be given up when it was learned that an earlier study by a Japanese scientist named Majima had led to the discovery of the same toxic principle in Oriental lacquer, which is made from the juice of a poisonous sumac related to poison ivy. Since the Japanese word for lacquer is "urushi," Majima named the poison "urushiol" — the "ol" indicating that it is an oily substance. Dr. McNair's analyses indicated that it is chemically a phenol, that is, a relative of carbolic acid.

His remedy was based on the idea of getting this oily poison to combine with some chemical element that would render it inert and harmless. He succeeded with ferric chloride: a 5% solution of this common chemical swabbed on the skin neutralizes the poison in very many cases. Not only that; if it is washed over the skin before you go where there is poison ivy, your chances of being poisoned are very much reduced.

There was one drawback to this treatment that is both prevention and cure: it left a brown stain on the skin, rather difficult to remove. Prof. George D. Fuller, University of Chicago botanist, got around this by substituting ferrous sulfate in the same strength. This dries out as a white powder and leaves no stain. These solutions may be made in plain water, but it is better to use 50% alcohol, with a little glycerine added.

These preventive-remedies are still in use, although later ones have partially supplanted them. One of the newest medical attacks on ivy poisoning is based on the fact that the redness, swelling and itching are symptoms of an allergy. The patient is therefore given one of the new anti-allergy drugs. These, however, are not to be purchased over the counter, but must be prescribed by a physician.

Best prevention of all, however, is not to come into contact with poison ivy. If ivy is growing in your neighborhood, learn to recognize it and avoid it. But best of all is to rid your neighborhood of the pest forever, now that this has been made possible through 2,4-D.

## Poison Ivy and Oak Are Sumacs

➤ Poison ivy, poison oak and poison sumac are strictly American plants—a somewhat dubious distinction. That is, they are North American plants,

for their range extends into both Canada and Mexico. They all belong to the same plant genus as the sumacs that blaze gloriously on our autumn roadsides and furnish the best tanning materials in the world. They are the black sheep of a worthy and useful family.

There are sumacs in Europe but none of them is poisonous. Two Asiatic sumac species are poisonous —and interestingly enough, they are the useful ones, for their sap is used in the making of lacquer. Even after it has been well seasoned, this lacquer is sometimes poisonous to sensitive skins. There was a rather widespread outbreak of skin rashes in this country a quarter-century ago, when the Chinese game, mah-jongg, was the current craze. Imported sets were finished with this lacquer.

Poison ivy and poison oak are easy to identify yet difficult to describe because they are so variable. They look enough alike so that the same basic description will do for both: gray-barked shrubs or climbing vines with three-parted leaves, clusters of inconspicuous greenish-white flowers in late spring, followed by rather soiled-looking white berries that persist through the winter.

Poison sumac looks very much like ordinary sumac, except for its fruit-clusters. Instead of the dark, upstanding clusters of the ornamental sumacs, it has drooping strings of pallid berries like those of its two cousins in crime. It is found only around acid-water bogs, or on sour, wet soils where such bogs have partially dried up. This is fortunate because nobody thinks of using such places as picnic grounds—or, indeed, for much of anything else. So although poison sumac is said to have the most virulent effects of the three it harms far fewer people because of its uninviting habitat.

Most of the popular identification of poison ivy and poison oak depends on their three-parted leaves, as witness the old jingle: "Leaflets three, let it be!" But beyond saying that the leaf has three leaflets, you can say almost anything else you like. They come in all sizes, from as small as the end of your thumb to as big as the palm of your hand, with margins either smooth, or slightly notched, or so deeply lobed as to resemble white-oak leaves. This diversity of shape is recognized in the botanical name of the poison oak of the West Coast: Rhus diversiloba.

This three-parted leaf is so nearly invariable on poison ivy and poison oak as to justify it as means of distinguishing these "baddies" from the harmless and ornamental Virginia creeper with its five-parted leaves and the cultivated ivy which has entire leaves. But the latter two sometimes play tricks, for three-parted leaves are sometimes borne at the young, fast-growing tips of Virginia-creeper vines and at the bases of cultivated ivy vines. So to make sure, the thing to do is look at a good many leaves, not just one or two.

Western poison oak is generally a shrub, and bushier than the shrub form of the Eastern poison ivy. It sometimes becomes a vine, however, and climbs trees. The poison ivy of the East is as diverse in growth habit as it is in leaf shape, with shrubby growth and climbing vines all mixed together.

The key to this puzzling performance seems to lie in the fact that poison ivy is always a vine, but that the vine runs along just under the ground surface or even on it, in some places and climbs trees, walls and stone fences in others. Where it climbs as a true vine, poison ivy clings by myriads of roots, which are an even surer identification mark than the three-parted leaves. Virginia creeper sometimes clings by aerial roots instead of tendrils, but where it does these roots are much sparser. Roots on the cultivated ivy vines are relatively sparse too.

This diversity in both leaf form and growth habit on the part of poison ivy is a headache to botanists. Some of them want to split it up into several species, but most now regard it as one highly variable species. Even the great Linnaeus, eighteenth-century founder of modern botany, stumbled in naming it from collected specimens that were sent to him in Sweden. Specimens of the vine form he called Rhus radicans, which means rooting sumac. Specimens of the shrub form he put into a distinct genus, to which he gave the appropriate Greek name Toxicodendron, meaning "poison tree." Now both names are combined into one: Rhus Toxicodendron.

Poison ivy is usually spoken of as an "Eastern" plant, to distinguish it from the poison oak of the West, which is strictly a plant of the Pacific Coast. However, poison ivy ranges far into the West, overlapping the northern end of the poison-oak territory in Washington and Oregon.

It is probable that there is more poison ivy now than there was when this country belonged to the Indians. It does not thrive too well in closed forest stands, and most of the country east of the Mississippi was dense forest then. It gets along better on forest edges or clearings, where there are trees to climb but plenty of chance to get sunlight. That is just what the destruction of the forests and the establishment of agriculture provided: stone walls and brushy fencerows with trees here and there, smaller blocks of timber, abandoned or ill-watched stone and brick buildings. Such places are a paradise for poison ivy. And when children play or men and women work in such places, such places call for spraying with 2,4-D.

## *Unbalanced Equations*

**Natural Resources Division**

*After the annual summer poison ivy warning broadcast, Science Service received a postcard with this query:*

➤ CAN YOU tell me what this Posen Ivory is that you say I can't go out in the woods without finding some? Where can I sell it and how much can I get for it?"

**Watch Water, Protein, Refrigeration In Summer Food Preparation**

# Hot Weather Food Hints

*by* JANE STAFFORD

➤ SOME GOOD hints on food in hot weather have just come from U. S. Department of Agriculture scientists. One concerns lettuce, that popular vegetable for tempting appetites on sultry days. Green, leafy garden lettuce is richer in vitamin A than the paler head lettuce. And because the green leafy kind from the home garden can be served soon after gathering, it also offers more vitamin C. But it does not keep as long as the market head lettuce. Home gardeners are therefore advised to pick only a little at a time, just enough for a one- or two-day supply. Good time for gathering lettuce or other garden greens is in the early morning after the cool night has given the leaves a chance to revive from the heat and sun of the day before. To save the vitamin C, don't add the salad dressing until just before serving, and don't use steel, iron or copper utensils or enamelware bowls for mixing and serving.

Second hint on food in hot weather is about how to keep it fresh and wholesome. Give the most perishable foods priority on the coldest space in the refrigerator, the specialists advise. The coldest space is usually nearest the freezing cabinet.

The foods which need coldest storage because they spoil most easily are: fresh and cooked meat, poultry and fish; meat broth, gelatin dishes; milk; milk-and-egg dishes like custard; and cottage or other soft cheeses.

In general, these very perishable foods keep best if covered. Uncooked meat should be loosely covered, or simply taken out of its wrappings and placed in the meat compartment of the refrigerator which provides it with enough ventilation for good keeping.

When putting foods in the refrigerator take care not to crowd them so closely together that the circulation of cold air around them is cut off. Let cooked food cool to room temperature before putting it in the refrigerator in order not to heat up the atmosphere inside and overwork the motor. However, as soon as the food has cooled, get it into the refrigerator promptly.

Don't skip the meat or other protein main course just because the weather is hot. Years ago there was an idea that one should eat less of such foods in hot weather. But the idea has been pretty well debunked, and scientists now tell us that our food requirements are about the same, winter or summer.

Because dinner is generally the main meal, it should provide from a third to a half of the day's nourishment. Too little protein at this meal generally means that the family runs short of this important nutrient.

You do not have to eat hot roast or meat stew for dinner to get the necessary protein. The main dinner dish

can be a salad and still provide protein if it includes eggs, cheese, or fish. Many housewives solve the hot weather dinner problem by roasting meat or frying chicken before the heat of the day and serving the meat or chicken cold for an appetizing dinner.

Don't let iced beverages crowd out your daily quota of milk. In hot weather you probably will be thirsty enough to drink both, and cold milk is itself refreshing. Or you can get your milk in cooked dishes or in cheese and ice cream.

The main difference the weather makes in the body's food requirements is in salt and fluids. In hot weather you perspire more because this is one mechanism for keeping cool. The extra water lost in this way should be made up by drinking more. With perspiration, salt as well as water is lost from the body.

If perspiration is very heavy, it is advisable to make up this salt loss also. This may be done by taking salt tablets, under a physician's direction. Some persons make a practice of sprinkling a little salt into their drinking water in hot weather. Home economists of the U. S. Department of Agriculture suggest serving salted vegetables as salads. This was the original meaning of the word salad, they point out in suggesting this way of resalting.

The picnic season is now on, which calls for a reminder of health dangers to be avoided at these pleasant gatherings. Every year, the official lists of outbreaks of food poisonings contain some that have been traced to foods eaten at picnics. Considering the number of picnics held, the number of outbreaks charged against them is relatively small. But, as Dr. Paul B. Brooks of the New York State Health Department points out, "when something does break loose and a lot of people get sick, even if it isn't dangerously, it creates an unpleasant situation, to say the least."

Water caused the trouble at a recent Sunday school picnic, he reports.

"Maybe water isn't a food but it goes with it and it's something to look out for," he says. "There was a well on the picnic grounds, with a pump. When a lot of 'em got sick, the investigation showed they'd patronized this well and the water was contaminated. Apparently they hadn't realized it but both parties took chances: the picnic ground proprietor when he left the pump there, and the picnickers when they drank water they weren't sure about."

About foods that can cause trouble, Dr. Brooks has this to say:

"There's one combination of foods and circumstances that's caused more trouble, probably, than any other: A protein food preparation that disease germs thrive in, handled by somebody that's carrying the germs (maybe from boils, a cold or sore throat or bowel trouble) and then the food allowed to stand at room temperature for several hours. If that doesn't cause an outbreak of gastroenteritis, it's just good luck.

"Cream filled pastries, ham or other meat preparations in sandwiches, chicken, fish or egg salads, or most any salad with mayonnaise: such things've been involved a good many times. The main precautions: no one that's ailing handling foods, and the

foods refrigerated 'til it's time to serve 'em."

Everyone knows that a baby's first food is milk, and most people know that children should go on drinking milk, a quart daily, along with other foods from babyhood until they have grown up. The reason is less well known. It is that all babies suffer calcium poverty when they are born. They are born calcium poor because their bones must be soft and flexible to survive passage through the relatively narrow birth canal in the mother's body.

Once safely born, however, the baby needs to catch up in calcium fast, to develop normally, nutritionists of the U. S. Department of Agriculture point out.

Milk is rich in calcium to supply this need. Unfortunately, many people remain calcium-poor throughout life for lack of enough calcium in their food. A child's growing body has greater need for calcium than many parents realize, and calcium deficiencies in both children and adults are much more common than many physicians realize because there is no good method of directly detecting them. Studies of American diets show that calcium and riboflavin—one of the B-vitamins—are the two nutrients that most often fall short. Milk is richer in both these nutrients than any other food. Whatever other foods must be skimped in budget meals, families should make sure that growing children get three to four cups or a nearly full quart of milk each day. Two cups is the minimum for adults.

Help in planning the family's food so that it comes within budget limitations without skimping on nourishment is given in a new publication of the U. S. Department of Agriculture. The plan, drawn up by the Department's Bureau of Human Nutrition and Home Economics, is for a family consisting of two teen age and two younger children besides the two parents. Cost of nourishing meals for this family according to the plan was $27 to $29 weekly at March, 1948, prices. Allowing for price fluctuations since then, it probably still gives the best buy for one's money.

On this plan, the housewife buys 14¼ pounds of leafy, green and yellow vegetables per week and serves some at least once a day to her family. Citrus fruits and tomatoes, to be served once daily if possible, total 13¾ pounds per week. Other items on the week's market list are:

Potatoes and sweet potatoes, to be served once or more daily, 20½ pounds. Other vegetables and fruit, for one to two servings daily, 11½ pounds.

Milk, cheese and ice cream, served two or three times daily and used in cooking, 32 quarts. (Count one ounce cheddar cheese or two to three large dips of ice cream as one cup of milk.) Meat, poultry and fish, served once daily if possible, 11¼ pounds. Eggs, four or more per person per week, 30.

Dry beans, peas and nuts, to be served one or more times a week, 2⅛ pounds. Flour, cereals and meal (flour equivalents), whole grain, enriched or restored served every day, weekly total 22¼ pounds. (Count 1½ pounds of bread as one pound of flour.) Fats and oils, some butter or margarine to be served daily, week's total 5¼ pounds. Sugar, sirups, preserves, 5 pounds.

# Tungsten

*by* Burton L. Hawk

▶ The bright glow of tungsten in the electric light bulb is familiar to all. But less familiar are the many other important roles that this valuable metal plays in industry; for it acts unseen behind the scenes without pomp or glory. It forms extremely hard alloys which practically revolutionized the tool industry. They are used in making axles of automobiles and steel rails. Other alloys are valuable in electronic devices such as anticathodes of X-ray tubes, filaments for radio tubes, contact points, etc.

Let us examine this important "lesser known" element in more detail.

## History

The existence of a new substance in certain Swedish minerals was suggested by Scheele as early as 1781. The same substance was discovered in the mineral *wolfram* by two Spanish chemists, the de Elhuyar brothers. In 1783 they succeeded in isolating the new metal by heating the substance (tungstic acid) with carbon.

Thus tungsten made its quiet appearance and then lay practically forgotten for almost a century before it was put to important use.

## Isolation

The reduction of tungsten trioxide, $WO_3$, is not easily accomplished in the home laboratory. Carbon or hydrogen could be used, but both require extremely high temperatures. Perhaps better results can be obtained by using metallic sodium as the reducing agent.

First, we must obtain the oxide. The most common compound of tungsten is sodium tungstate and we will use it as our starting point. Dissolve 3 grams of it in 15 cc. of water. Add to this a solution of 5 cc. hydrochloric acid in 5 cc. of water. A white precipitate of tungstic acid forms which rapidly turns yellow. Filter, and transfer the precipitate to an evaporating dish. Heat gently until all water is driven off. Grind the remaining solid to a fine powder in a mortar. Finally, heat again strongly for about 10 or 15 minutes. The powder will turn dark orange but will regain its yellow color on cooling. This is tungsten trioxide, $WO_3$.

Sodium is a powerful reducing agent and sometimes dangerous; therefore proceed cautiously. Place a *small* quantity of thoroughly dry tungsten trioxide in a thoroughly dry porcelain crucible. Cut a small piece of metallic sodium—*no larger than a pea.* Clean it, cut into several smaller pieces, and drop into the crucible with the tungsten trioxide. Immediately cover the mixture with a layer of common salt, about $\frac{1}{4}$ inch thick. Place a loose fitting cover on the crucible and apply moderate heat. The action should proceed quietly, but it is best to place the apparatus in a place where no danger will occur from flying sparks in the event the sodium becomes a bit obstreper-

ous. Heat for about 15 minutes; then let the crucible cool thoroughly before removing the cover. When cool, carefully shake out the layer of salt. The bottom of the crucible will be covered with a black, brittle powder which, if your experiment was successful, is tungsten. If all the sodium has not reacted it will be necessary to heat again under the layer of salt. Of course you are familiar with the explosive reaction of sodium and water; it will not be necessary to caution you against the careless use of the latter in extractiong the metal or washing the crucible. As the tungsten requires a temperature of 3370 degrees to melt it, we will have to be content to leave it in powdered form.

**Identification**

The "blue oxides of tungsten" present a characteristic test for the presence of that element. Add a little hydrochloric acid to a solution of sodium tungstate and drop in a small piece of zinc. The precipitate formed is first white, then yellow, and finally passes through various shades of blue. The latter color is formed by the reducing action of the hydrogen bubbling through the solution. If potassium ferrocyanide be added to the acid solution instead of the zinc a greenish orange-yellow color is obtained. Stannous chloride gives a white precipitate.

We have found that the easiest way to obtain tungsten is to break an electric light bulb. If you can obtain such a bulb, it will be interesting to verify the composition of the filament. We refer to that portion of coiled, brittle, white wire suspended from wire supports in the center of the bulb.

Our first difficulty is to bring the tungsten into solution. It is scarcely attacked by acids, even by aqua regia. The powdered metal will dissolve in boiling KOH solution, but the solid metal, as in the filament, will not. Our only alternative, then, is fusion with alkali. Place one or two grams of solid sodium hydroxide in an evaporating dish. Add a small piece of the filament-wire and heat until the solid melts and most of the metal is dissolved. Sodium tungstate is formed. When cool, dissolve in water. Make acid with HCl and add a piece of zinc. The blue color betrays the presence of tungsten.

But suppose you have followed instructions and no blue color is obtained? When you added water to the fused alkali, was a white precipitate formed at first which dissolved when more water was added? If so, in all probability you have a solution of sodium tantalate and your filament was not tungsten, but tantalum.

**A Swedish wood-preserving method, now being investigated in America, uses arsenic acid, sodium arsenate, sodium bichromate and zinc sulfate; the arsenic kills the fungi and insects, the others retard leaching of the arsenic.**

**American automobiles use many imported materials including chromite for rustless finishes, vanadium for strength of springs, tin for solder and alloys, antimony to give batteries heat-resistance, and rubber for tires.**

**International Clearing House Needed For Peaceful Isotope Distribution**

# U. S. Isotope Monopoly Dangerous

➤ "NON-DANGEROUS" isotopes, by-products of the piles which are used to make atomic bombs, should be distributed by an international office of the United Nations.

This proposal by the Federation of American Scientists emphasizes that the isotopes are important for research in medicine, agriculture and industry but are not useful for making atomic bombs. The suggested international office would set standards for the handling and naming of the isotopes in addition to serving as a clearing house for distribution of the material.

Although the U. S. has a near monopoly of these isotopes at present, small uranium piles which can produce these important by-products are now operating in Canada and Great Britain. In France and probably the U.S.S.R., such piles are scheduled for early construction and operation. Other countries listed as planning production of isotopes are Sweden, Norway, and India.

Setting up an office for international distribution of isotopes would aid the international exchange of scientific information, counteract ill feeling toward this nation by some scientists abroad and advance the peaceful uses of atomic research, the report contended.

Warning of a "disturbing change" in the attitude of some scientists in non-English-speaking countries toward the U. S., the report declared: "Upon investigation we believe most of the accusations and suspicions regarding American behavior to be unwarranted, but the circumstances are such that denial is difficult or impossible."

The report suggested that an international organization such as the United Nations Atomic Energy Commission, the World Health Organization or the United Nations Educational, Scientific and Cultural Organization call an international conference on isotopes.

Such discussions might lead to an executive agreement or charter setting up an international office within the United Nations framework to deal with the distribution of isotopes.

Distribution of isotopes by a UN group might not help in reaching an agreement in the control of atomic weapons, but the report said that an international institution operating in the field of atomic energy might "modify some viewpoints regarding control." Prof. Arthur Roberts, physicist at the State University of Iowa and chairman of the Federation, said that "the proposal might well be undertaken by the United Nations Atomic Energy Commission if the General Assembly deems it advisable."

Mildew is not a simple stain as many believe; it is a fungus growth that eats into the fabric, causing permanent damage.

**Source of Organic Chemicals Sought in Annual Crop Plants**

# Sugar as Raw Material for Industry

➤ FROM THE common sugar used on your dinner table, the chemist can now make drugs, plastics, flavorings, auto antifreeze, solvents and a host of other useful materials, usually obtained from coal or oil.

For research that promises to develop sucrose (ordinary sugar) as a key raw material of industry, Dr. Leslie F. Wiggins of the University of Birmingham, England, was recently given the Sugar Research Foundation's third annual $5,000 prize.

Dr. Wiggins has shown that sugar can become the source of almost as wide a range of important organic chemical compounds as coal tar, long the raw material of drugs, dyes, plastics and other chemical products.

The principal pathway to using sugar is through an intermediate chemical, levulinic acid. Dr. Wiggins believes that levulinic acid can become to sucrose what benzene is to coal.

Using an efficient method of converting sugar to this acid, Dr. Wiggins has produced from it such varied products as sulfa drugs, nylon ingredients, and a synthetic coconut flavor. A permanent auto antifreeze, that will not boil out of radiators like alcohol, has been found in the calcium salt of levulinic acid, which probably can be made more cheaply than glycol or glycerine now used.

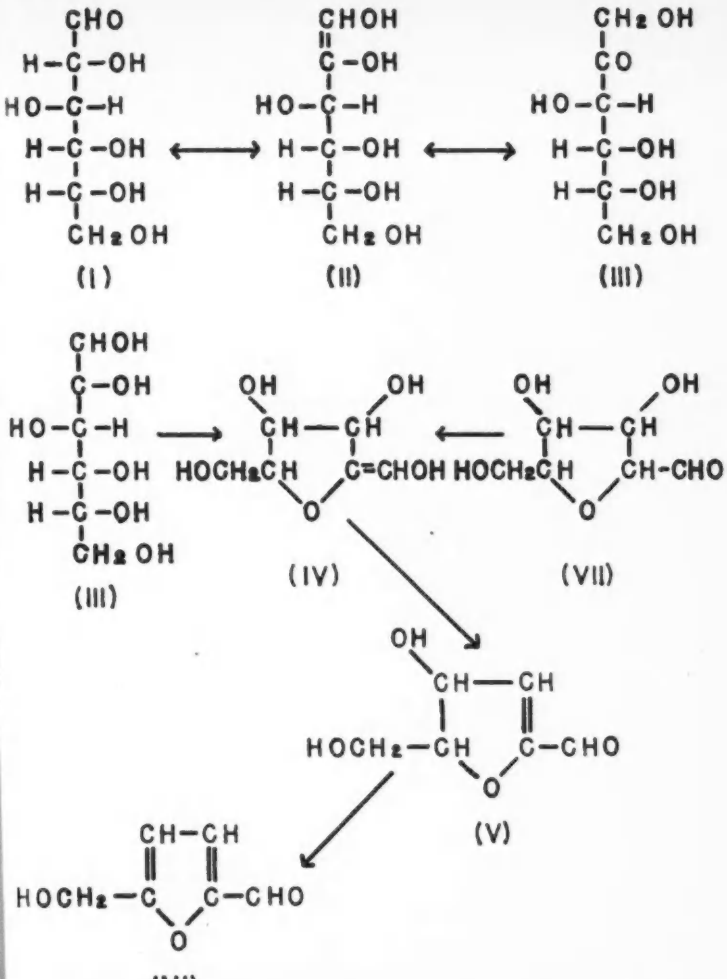
Drugs useful for reducing blood pressure, solvents, emulsifying and wetting agents, and a wholly chemical method for producing industrially valuable lactic acid have been developed. Through these channels it is expected that quantities of sugar will enter a wide range of uses from acrylic-type resins to solutions for treating hides.

Chemists have learned how to produce vast quantities of sugar at low cost. Dr. Robert C. Hockett, scientific director of the Sugar Research Foundation, emphasized the world interest in such production of a continuing supply of raw material from growing plants, instead of using irreplaceable coal and petroleum. For that reason American studies of sugar as a food and industrial material are being supplemented in England through the Colonial Products Development Council and at the newly created Imperial College of Tropical Agriculture in Kingston, Jamaica.

## Levulinic Acid Formation

➤ IT MAY be opportune, Dr. Wiggins states in a publication describing the preparation of levulinic acid from sugar, to consider by what mechanism levulinic acid is formed from different carbohydrate sources. Obviously when disaccharides and polysaccharides are used, the first step is the hydrolysis of these to hexoses. If therefore, we develop a mechanism for sucrose, such may be applicable to cellulose, starch, inulin and all hexose-containing disaccharides.

When sucrose is treated with acid,



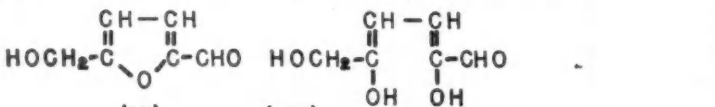

➤ BY THIS SERIES *of equations the author is trying to show the dynamic changes that he believes take place in the transformation of sugar into levulinic acid. Chemists are trying to find a readily reacting substance which will allow them to get a variety of useful chemicals from annual crop plants. Dr. Wiggins believes levulinic acid from sugar is one answer to the problem.*

the first result will be the formation of fructose and glucose. If these are written down in the open chain form as I and II it is readily seen that both give rise to one and the same 1:2 enediol (III) and it is very probable that this hypothetical enediol is all important in the conversion of hexoses to levulinic acid. The next important step to consider is the formation of 5-hydroxymethyl furfural from the transitory enediol (III), possibly through the stages (III) → (VI).

There is some factual basis for this scheme, because chitose, the anhydro sugar obtained on de-amination of glucosamine, which almost certainly has the structure (VII), can very readily be converted into 5-hydroxymethyl furfural on being treated with 0.3% oxalic acid. That this hydroxymethyl furfural can easily be converted into levulinic acid and formic acid was clearly demonstrated by Teunissen; it therefore appears that the essential steps in the formation of levulinic acid from aldoses and ketoses are as follows:

aldose or ketose → 1:2 enediol → 5-Hydroxymethyl furfural → Levulinic acid and formic acid.

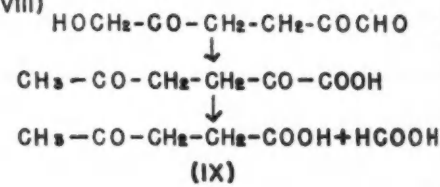
One possible mechanism for the last step is represented by the changes (VI) → (VIII) → (IX).



(VI)



(VIII)



(IX)

The production of equimolar amounts of levulinic and formic acids, as shown by step IX, is in accordance with experimental fact. This concomitant formic acid production is of industrial significance because of the commercial value of formic acid esters and formamide as solvents.

Levulinic acid is obtained from dilute sucrose solutions by acidifying, filtering off the black humin material which separates, and extracting the clear filtrate with ether. The ether extract is concentrated by evaporation to a syrup which is distilled at 100°. This separates the formic acid, and the residue, upon cooling, crystallizes as levulinic acid. It has been found that hydrobromic acid is the most efficient acidifying agent, but, since its high cost makes its use impractical on an industrial scale, an efficient substitute is hydrochloric acid with 1% sodium bromide. The acid solution, after ether extraction, is boiled free from ether, then used again with fresh sucrose. Increase of temperature and pressure seem to increase the yield of levulinic acid.

**Processes, Apparatus, Methods Among U.S. Patents in Chemistry**

# Patents on Chemical Inventions

*For twenty-five cents each you may obtain complete specifications of any patent from the U.S. Commissioner of Patents, Washington 25, D. C. Order by number and enclose currency or money order, but not stamps. Coupons for the purchase of patents may be obtained in quantity from the commissioner, at the same rate.*

## Compact Neutron Source

➤ A SMALL and simple but important device used in the development of atomic energy has been given the protection of U.S. patent 2,440,999, assigned to the U.S. Atomic Energy Commission by its inventor, Herbert L. Anderson of Chicago. It is described as a compressed neutron source.

Neutrons are the uncharged atomic particles that proved to be the effective missiles in bombardments that burst the hearts of unstable large atoms, with revolutionary release of energy. It is desirable to have the bombarding neutron streams come from a source with the smallest possible dimensions—the ideal would be a single dimensionless point.

To approach this condition as closely as possible, finely powdered beryllium metal is mixed with a solution of radium bromide which has been freed of radioactive decomposition products by boiling. The mixture is formed into a cylindrical pellet slightly more than three-tenths inch in both height and diameter, in a press capable of applying pressure above ten tons per square inch.

This pellet, tightly sealed in a brass cylinder, becomes the source of the desired neutrons.

## Rubber Carries Insecticides

➤ USE OF A DUST of minute rubber particles to carry certain insecticides, in place of the customary mineral dusts and oil droplets, is proposed by a U.S. Department of Agriculture chemist, Charles W. Murray. He has assigned rights in his patent, No. 2,440,781, royalty-free to the government.

## Continuous Alcohol Process

➤ A CONTINUOUS-PROCESS method for the production of industrial alcohol is the subject of patent 2,440,925, issued to B. C. Boeckeler of Grosse Ile, Mich. As fermentation approaches completion in the initial vessel, part of the mash is drawn off and subjected to distillation; meanwhile new wort is introduced at the starting-point.

## Fruit By-Products

➤ VALUABLE by-products are recovered from fruit pulp or pomace in the process on which E. K. Metzner of Los Angeles has obtained patent 2,440,907. First the pomace is heated, to drive off the alcohol, which is recovered. Then the remaining pomace is treated to separate out the nitrogenous constituents, and finally to recover the tartrates.

## Pineapple Growth Control

➤ PROBABLY THE MOST completely chemically-controlled crop plant in the world is the pineapple. Synthetic growth-control substances time its flowering, speed or hold back its ripening, kill the weeds in its fields. To Dr. F. P. Mehrlich of the Hawaiian Pineapple Company has been awarded patent 2,441,163, on the use of three synthetic hormones of the naphthalene acetic acid group. Principal effects were postponement of ripening, increase in size of fruit and strengthening of its stem.

## Steel Strip Testing

➤ STEEL STRIP, the stuff that automobile bodies and a thousand other industrial products are made of, can now be continuously tested for thickness and temper, as fast as it is produced. Patent 2,441,283, on apparatus for doing this, has been granted to Charles M. O'Hara of Gary, Ind., and assigned to the Carnegie-Illinois Steel Corporation.

The strip is passed through two roller gauges. The rollers of the first are under just enough pressure to measure its thickness; those of the second are screwed tight enough to squeeze into the steel a little, measuring its hardness. Data from both gauges are electrically recorded.

## Rotary Kiln For Shale

➤ LOOKING toward the time when this country will have to depend on oil shales for liquid fuel and lubricants, C. H. O. Berg of Long Beach, Calif., has developed an extraction process in which ground shale is passed through a rotary kiln, along with recycled spent shale that has already been through once. This is to prevent the formation of coke masses while the oil is being "cooked" out.

## Sulfate Production

➤ A METHOD for producing two chemicals in high industrial demand, chlorine and sodium sulfate, is covered by patent 2,441,550, assigned to the Chemical Foundation, Inc., by two Columbia University chemists, Prof. A. W. Hixson and Dr. Ralph Miller. First sulfur is burned to produce sulfur trioxide. This is liquefied and concentrated, then added to common salt (sodium chloride), to form sodium chlorosulfonate ($NaSO_3Cl$). Upon heating, this breaks down into sodium sulfate, chlorine and sulfur dioxide. The first two are removed for marketing, the latter is converted into sulfur trioxide for further use.

## Iron Ore Up-Graded

➤ IN ANTICIPATION of a time when it will be necessary to use lower-grade iron ores, a process for improving them by conversion from non-magnetic to magnetic state has been developed by Charles F. Ramseyer of Old Greenwich, Conn. It consists simply of grinding the ore to a fairly fine powder, then heating it for a few minutes in the presence of a reducing gas such as hydrogen or carbon monoxide, at a temperature between 500 and 1,000 degrees Fahrenheit.

About one-fourth of the iron in each particle is thus rendered magnetic, which permits the workable ore to be separated from the worthless mineral or gangue by passage (preferably in a wet condition) over a suitable electro-magnetic device.

U. S. patent 2,441,594, issued on this process, has been assigned to

H. A. Brassert and Company, of New York.

### Iron Powder

➤ HIGH-PURITY iron powder for chemical and metallurgical uses is made more cheaply than formerly in the process on which William J. Kroll of Niagara Falls, N. Y., has taken out patent 2,441,770. By this method, anhydrous ferrous chloride is reacted with anhydrous ammonia at a temperature between 500 and 675 degrees Centigrade, and the nitrided iron thus produced is then reduced, yielding pure iron, finely powered.

### Cocoa Treatment

➤ UNDESIRABLE flavors are removed from cocoa by treatment with superheated steam under partial vacuum, in the method on which a Swedish inventor, Olof E. Widen of Ljungsbro, has been granted patent 2,441,861.

### Penicillin Production Improved

➤ PENICILLIN is produced in higher concentration, and with less tendency to break down before it can be removed from the culture fluid, by a new method of feeding the molds that secrete it, developed at the Northern Regional Research Laboratory of the U. S. Department of Agriculture in Peoria, Ill. Rights in U. S. patent 2,442,141, issued on this method to Dr. Andrew J. Moyer, have been assigned royalty-free to the government.

Carbohydrate food is the same as in the processes now employed, either glucose or corn-steep liquor; but instead of being put into the solution all at once it is added gradually. Another novel feature is the addition of considerable quantities of protein, which may be by-products of the dairy industry such as whey or hydrolyzed casein, or hydrolyzed wheat gluten, synthetic amino acids or the like.

### New Geiger Counter

➤ WHILE MANY public figures seem to be growing increasingly excited over security aspects of atomic energy, the Atomic Energy Commission itself finds it possible to release certain non-military facts through patent disclosure. Latest is patent 2,442,314, issued to Allen F. Reid of New York and assigned to the A.E.C. It is on a new type of Geiger counter in which the quenching gas is a hydrocarbon containing six carbon atoms, combined with a single atom of fluorine or other halogen element, instead of the lead tetra-methyl now used.

### Humidity Control

➤ AN ELECTRIC refrigerator in which the desired humidity level is maintained in one of the compartments by circulating through it air that has had excess moisture frozen out of it in a colder part of the machine is the subject of patent 2,442,188, assigned to the Philco Corporation by its inventor, John J. Bauman of Abington, Pa.

### Radio Dehydration

➤ AMPOULES of drugs and other materials can be treated with high frequency radio waves for dehydration and certain chemical effects in an apparatus on which patent 2,442,114, issued to George H. Brown of Princeton, N. J., has been assigned to the Radio Corporation of America. The radiation is applied to a bank of ampoules held under vacuum in the enlarged end of a coaxial conductor.

### Citrus Extraction

➤ HESPERIDIN, a bitter medicinal principle occurring in citrus fruit rinds, is extracted by treatment with lime, then crystallized by addition of hydrochloric acid, in the process on which W. E. Baier of Ontario, Calif., has obtained patent 2,442,110, assigned to the California Fruit Growers Exchange.

### Antibiotic From Bee Disease

➤ A GERM that brings wholesale death to honeybees may provide a strong weapon for the defense of human and animal health, it has been discovered at the bee culture laboratories of the U. S. Department of Agriculture at Beltsville, Md., by Dr. Eugene C. Holst.

The germ is the one that produces the serious disease of infant bees known as American foulbrood; its scientific name is Bacillus larvae. From it can be produced, either by direct extraction of the "scale" which it causes or by culturing on a nutrient medium, an antibiotic, or drug of the same family as penicillin and streptomycin. The new antibiotic has not yet been formally christened.

Among the bacteria against which the new substance has been found effective, in laboratory tests, are those that cause boils, blood poisoning, septic sore throat, undulant fever, spontaneous abortion in cattle, and both human and bovine tuberculosis. It has an unusually wide range of effectiveness, although some germ species do appear to be resistant to it. Much more work on experimental animals is considered necessary before clinical use can be undertaken.

On his discovery, Dr. Holst has been granted U. S. patent 2,442,006, which he has dedicated to the free use of the people of the United States.

## *New Fabric, Gold or Silver Colored*

➤ GOLD or silver-colored fabric, of a new type, has many decorative uses in the home. It is a metal-coated plastic fabric that has a mirror-like finish. Its uses range from lamps to window shades.

The base material is a mesh that resembles ordinary wire screening with the spaces filled with a cellulose acetate film. The fibre of the mesh is saran, a well-known plastic, a compound of polyvinylidene chloride.

The mesh with acetate filler is coated on one side with a thin film of aluminum applied by a high-vacuum evaporation process. This, as well as the gold or silver color, is covered with a protective lacquer. Over the silver finish is a clear lacquer; a gold-colored lacquer is used for the gold finish.

Because of its mirror-like finish, the new material will be known by the trade name Miramesh. It is a product of the National Research Corporation, Boston. It can be stitched, or cemented provided the cement does not include solvents that will attack the acetate. It is not suited for uses where it will be subject to repeated bending because the acetate may separate, leaving the mesh bare.

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**Experiment 5**—You are now ready to put your cell together. Push the bottom washer down in the zinc can until it lies flat on the bottom. Pour a little of your flour-and-water paste into the zinc can until the can is nearly half full. Dip the cloth-covered end of the bobbin into a glass of water, quickly remove, shake off excess water and force into the zinc can until it is all the way to the bottom and resting on the washer. This will cause the paste in the can to rise so that a little covers the cloth-protected mix.

Fit the top collar over the brass cap at the end of your carbon rod and force it down into the zinc can until it is about an eighth of an inch below the can top. Your dry cell is now ready to be sealed.

**Experiment 10**—Dip your piece of blotter in the salt water and place

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on a clean flat surface. Wet the litmus paper with the salt water and arrange on the damp blotter.

Bend a small lop in the end of one of your tinned copper wires. Be sure that the loop is smaller than the brass cap of your dry cell as you made it in order to bring more wire into direct contact with the center post. With the first finger of your left hand hold the wire loop against the brass cap. With the thumb of this same hand hold an end of the other copper wire against the bottom of the cell. Hold them tightly against the dry cell so you will have good contact.

Place the free ends of both wires across the litmus paper. Do not allow the two wires to touch each other at any point or the demonstration will fail.

Ask your friend to use a lead pencil to press the wires tightly against the litmus paper. Hold this position for almost 15 seconds, then remove the wires from the paper. How has the litmus paper been affected? Now reverse the dry cell so that the wire connected to the center post touches the opposite end of the litmus paper, and repeat the experiment. What happens now?


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